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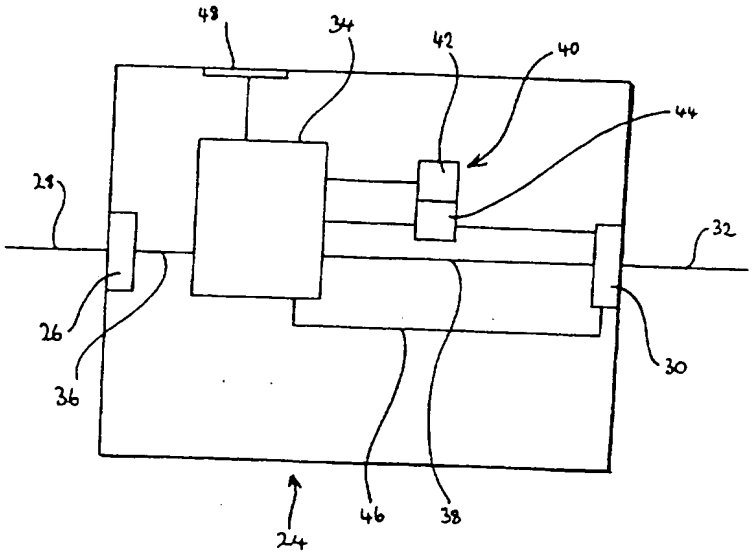
(54) Network access apparatus

(57) The network access apparatus 24 has a processor 34 which controls the particular route that communication information takes over a network (12,Fig.1) in dependence on configuration data in a non-volatile memory 44. The memory 44 is reprogrammable over the network (12) by a Down-Line Load Centre (DLLC 16) when the user establishes a connection therewith and then operates a switch 48 to place the apparatus 24 in a configuration mode. The DLLC (16) uses multi-frequency signalling. The apparatus 24 serves to deliver the communication information over the network by way of a particular route determined by the customer's location and service requirement. For example, a user's call can be directed so as to travel along a "least-cost" route or, if required, be routed to a particular intelligent network service (18). The access apparatus 24 can be readily configured, and re-configured, in a quick, simple and cost-effective manner so as to take account of any further intelligent network feature incorporated into the network and which may be of interest to the user and also to take account of any changes that might need to be made to the national number codes etc. The apparatus 24 may have a default setting which can be overridden to obtain further access options if the user dials an override code.

Fig. 2



GB 2 298 335 A

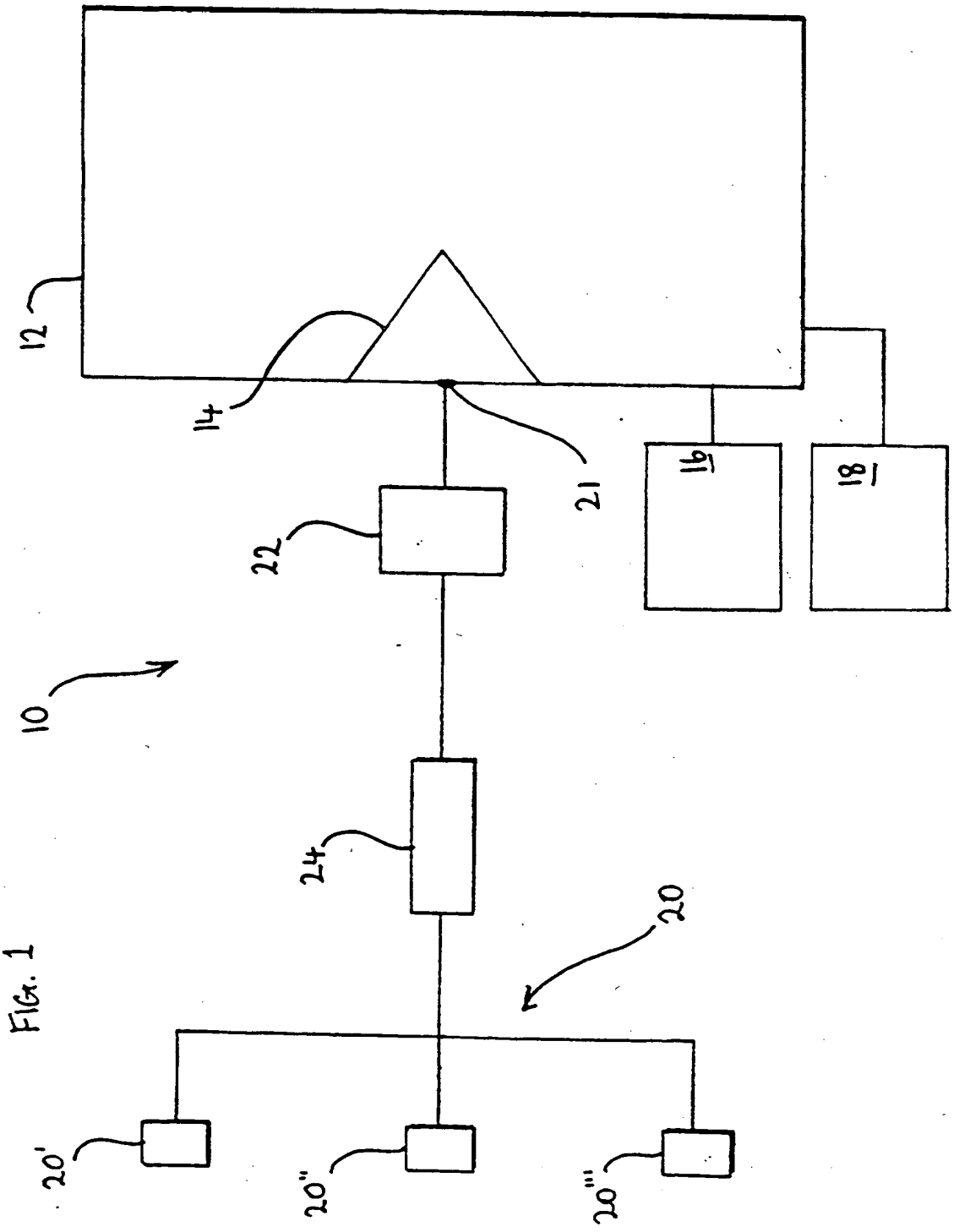


FIG. 1

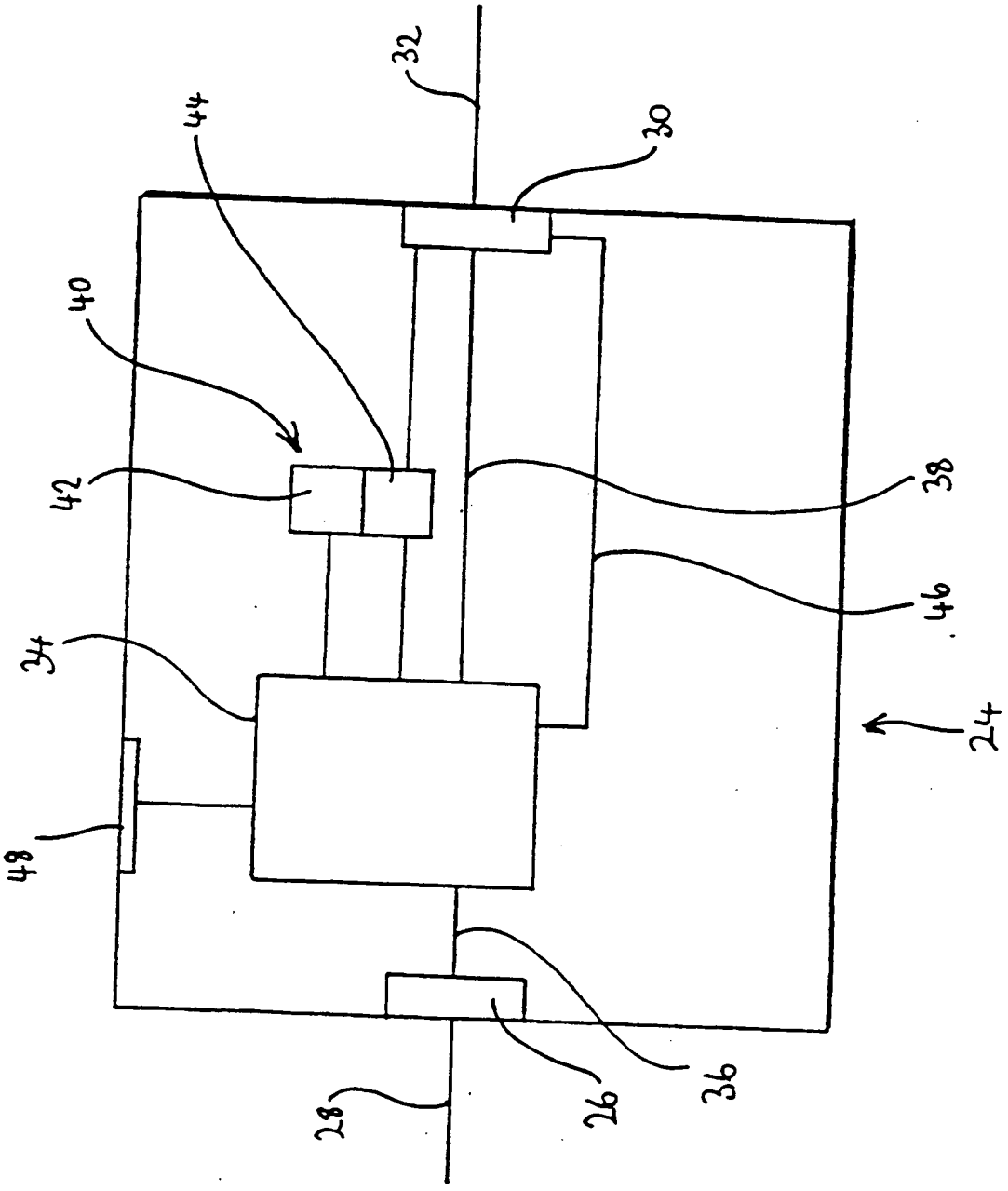


FIG. 2

NETWORK ACCESS APPARATUS

The present invention relates to network access apparatus and in particular to apparatus serving to determine the route taken by communication signals over the network.

Network Access Apparatus generally comprises Customer Network Access Equipment (CNAE) interposed between a customer's main equipment, which can comprise any form of telecommunications terminal equipment, for example modem fax machine, PC and/or telephone and a network termination point, operates by interrogating the call set-up sequence dialled by the user and in turn sends a network call set-up signalling sequence to provide access to a particular route, and/or destination. For example, if the call made by the user is to be routed through one applicable system, then on receipt of a dialled directory number, the access apparatus prefixes the dialled number with an appropriate local access code and, if required, a customer authorisation code. The call is then routed to the required system. The required system may be one that offers a cheaper call tariff and/or one that offers intelligent network features.

Much of the route-information processing depends on the location of the customer's terminal with respect to the intended destination. This relative location is generally indicated by a directory number of the intended destination. On this basis, since certain special service calls must be routed through the local system to the customer's terminal, and calls to the directory numbers in the local call area are generally cheaper through the local system, an exclusion table is generally provided in known customer network access equipment which includes lists of national number groups, and details of the short code

directory numbers, in respect of calls that should be routed through the local applicable system.

Since it is necessary to provide customer network access equipment that meets the particular requirements of each customer, having regard to their relative locations in the network, each CNAE is generally configured differently, dependent upon the customer's requirements.

The introduction of intelligent network services and features increases the number of potential call destinations and can increase the demands made on the CNAE.

Such known equipment is disadvantageous not only in view of the increased expense in providing "particularly configured" equipment for each customer, but also because of the time-consuming, administratively complex and expensive updating procedure needed when, for example, national number codes are altered and/or further call routeing options and destinations such as intelligent network services and features are connected to the network.

The present invention seeks to provide a Network Access Apparatus (NAA) having advantages over known CNAE.

In accordance with one aspect of the present invention there is provided network access apparatus comprising input means for receiving network access information from network terminal equipment, processing means for receiving said input information, output means connected to said processor means and for delivering a processed information signal to said network, said processing means being arranged to determine the route information is carried over the network on the basis of configuration information received thereby, wherein said processing means has means for receiving said configuration information from said network and for storing

the same for subsequent use.

The invention is particularly advantageous in that the network access apparatus can be remotely configured over the network when installed at a customer's terminal. Thus, the network access apparatus initially supplied can be common to all intended customers and this can assist in reducing the cost of such apparatus. As and when required, i.e. to first configure the apparatus, or in order to re-configure the apparatus, for example to allow for changes in national number groups, to provide additional or changed routeing options or to allow for the inclusion of further intelligent network features on the network, the network access apparatus can be readily configured or re-configured over the network from a Down-Line Loading Centre and without requiring the removal of the network access apparatus from the customers terminal and so without suffering the related increased cost and terminal "down-time" disadvantages. To this end, means are provided whereby the network access apparatus can be configured, and subsequently re-configured by the Down-Line Loading Centre.

Further, the apparatus can be advantageously arranged to receive network access information comprising multi-frequency signalling information. Also, the processing means is arranged to receive configuration information using multi-frequency signalling information. This can assist in removing the need for a true modem communications system.

In accordance with a particular feature, the processing means can be provided with internal logic states arranged to be determined by a programmable state table.

Advantageously, the apparatus can be arranged to provide for a transmission path for all communication

traffic once the initial call has been set up using digit translation logic of the processing means. A changeover in modes of operation of the apparatus can then be achieved when the apparatus is not required to perform any further processing.

The processing means is arranged for operation with a control program memory location and a user data memory location. These two locations can be discrete locations or integrated and, if required, the information to be stored in both the locations can be delivered from the network. In particular the control program memory is non-volatile. The user data memory is also non-volatile and arranged to receive said configuration information from the network.

The invention is advantageous in that the user data memory can be arranged to receive configuration information in a state table for defining dialled-code manipulation logic. This provides for a high degree of flexibility so that the state-table can be re-configured if or when the apparatus is required to perform different code translations.

Further, the user data memory can be arranged to receive and store configuration details and data tables as received from the network.

The network access apparatus can operate within four functional states. In a first state the access apparatus is off-line and is transparent to ringing signals. In a second split-line state signals sent to the network by the network access apparatus, and received from the network, are not to be heard by users of the customer main equipment. In a third state the network access apparatus is transparent to all signals and in a fourth state said processor can be configured from the network.

In accordance with a particular feature, the network access apparatus is configured to route the call on the basis of the likely least-cost route available. Also, or alternatively, the network access apparatus can be arranged to route a requested call to an alternative network routeing or intelligent network feature required by the user.

The network access apparatus can be configured to bar the use of certain local access codes.

The processing means is configured to operate checksums so as to confirm that configuration information delivered from said network has been correctly received. The network access apparatus can advantageously then ensure that configuration information sent over the network has been correctly received.

In particular, the network access apparatus can be arranged to allow for the passage of a request from telecommunications terminal equipment to said network so as to commence the supply of configuration information from said network.

Some particularly advantageous features of the invention are as follows. The remote configuration of the network access apparatus allows for the use of the apparatus on a PBX extension, where the directory number may be prefixed by the PSTN access digits.

A default access procedure can be provided whereby, upon dialling the directory number or intelligent network list number, a suitable access code is added to the code stream to cause the call to be routed through the required system or to the required intelligent network feature. Further, if the default option is not required, the

dialling of a single-digit user entry code, may permit the user to make use of an alternative line access code or omit the local access code to live routeing by the local system.

Another feature is that the automatic transmission of a customer authorisation code is used when a calling line identification code is not available. The user can also enter a cost centre code number for his own use.

What constitutes a local call is dependent upon the customer's national number group. Different exclusion tables are required for each area, and the initialisation and maintenance of these tables, can be provided via the network in accordance with the present invention and this serves to overcome particular disadvantages found in the prior art. Also, the network access apparatus of the present invention allows dialled number manipulations that are required, and also situations in which access codes are to be inserted, parts of the dialled number are to be deleted, and where other parts are to be re-arranged.

Further, said apparatus may include a default setting and means for overriding said default setting to offer further access options.

According to another aspect of the present invention there is provided network access apparatus comprising input means for receiving network access information from network terminal equipment, processing means for receiving said input information, output means connected to said processor means and for delivering the processed signal to said network, said processing means being arranged to determine the route of said information over said network on the basis of configuration information received by said processing means, wherein said apparatus has a default setting and means for overriding said default setting to

offer further access options.

The default setting can advantageously be overridden by means of a dialled code, in particular as described hereinafter.

The invention is described further hereinafter, by way of example only, with reference to the accompanying drawings in which:

Fig. 1 is a block diagram of part of a network connected to a terminal having network access apparatus embodying the present invention; and

Fig. 2 is a block diagram showing particular features of the network access apparatus of Fig. 1.

Turning to Fig. 1, there is shown a block diagram representative for example of a portion of a network 10 employing an embodiment of the present invention. The network 10 comprises the Public Switched Telephone Network (PSTN) 12 having a local applicable system 14 forming part thereof. Remote locations generally outside the PSTN 12 are provided with a Down Line Load Centre (DLLC) 16 and intelligent network services 18.

A customer's terminal 20, comprising customer main equipment such as a telephone 20', fax machine 20" and modem 20"', is connected to the network by way of a network termination point 21. In the illustrated example, the customer main equipment 20 is located on an extension of a private branch exchange 22 itself having an output connected to the network termination point 21. The Network Access Apparatus (NAA) 24 is a customer network access equipment which according to an embodiment of the present invention, is located on the extension of the private

branch exchange 22 so as to be located between the customer main equipment 20 and the private branch exchange 22. However, it will of course be appreciated that the NAA 24 can be connected directly to the network termination point 21 if no private branch exchange is present.

Referring now to Fig. 2, the NAA 24 is shown in greater detail. The NAA 24 includes a signal input 26 for receiving call request signals from the customer main equipment and for subsequently receiving the communications data by way of a connection line 28. The NAA 24 also includes a signal output 30 for delivering appropriately processed network access information, and subsequent communications signals, to the private branch exchange 22 by way of an output line 32.

Within the NAA 24 there is provided a processor 34 which serves to process the call-request signal received from an item of customer main equipment 20 as will be described in further detail below. The processor 34 receives the call request information from the input 26 by way of the line 36, and then delivers the processed signal by way of line 38 to the output 30. The processor 34 is controlled by information stored in a memory 40 which is itself divided into two main memory locations 42, 44. In practice the locations 42, 44 need not be discrete and can be distinguished on the basis of whether they can be configured from a Down Line Load Centre as described later. The first memory 42 comprises a memory location which is non-volatile and is arranged for the storage of standard code required for the operation of the NAA 24 which is dependent on the customer's requirements. Secondly, the memory 44 comprises a customer data memory location which is also non-volatile and is arranged to be loaded by down-line loading in accordance with an embodiment of the present invention. The processor 34 is also arranged to

provide for control of the output 30 by way of a control line 46 so as to effectively switch between the various states required of the NAA 24 to achieve the desired function and configuration.

The use and operation of the apparatus according to the illustrated embodiment is now described in further detail.

The NAA 24 is particularly arranged to accept signals received in a defined sequence from the customer main equipment 20 and to interpret public switched telephone network and private branch exchange supervisory voltages and currents. The NAA 24 transfers supervisory conditions, access codes, directory numbers and the list numbers appropriate to each intelligent network feature, and any other appropriate codes, to the private branch exchange 22. Further, the NAA 24 is also arranged, except when in a so-called "split-line" state to be described later, to provide for a transparent transmission path for the communication data to be passed between items of customer main equipment 20 and the PSTN 10. Most importantly, when in the so-called configuration state to be described later, to the NAA 24 is arranged to be configured, from the DLLC 16.

As regards the operation of the NAA 24, the apparatus is arranged such that all required signalling is achieved by way of MF signalling. When in the configuration state, the NAA 24 is arranged to identify, process and store MF digits received at the port 30 via the public switched telephone network from the DLLC 16. Further, when the NAA 24 is in the so-called "call set-up" state, it is arranged to identify and process digit streams received from the customers main equipment 20 at the input port 26. In operation, the NAA 24 is arranged to be transparent to both time-break recall and earth recall signals received from

the customer main equipment 20.

Particular features of the NAA 24 according to the illustrated embodiment are that, when in the configuration state, the NAA 24 identifies supervisory conditions and signal codes received from any particular network termination point 21 or private branch exchange extension line, and that when in the split line state, the NAA 24 identifies the conditions and signal codes received from the customer main equipment via the port 26. Also, when in the split line state, the NAA 24 is arranged to send a call set-up signalling sequence to the network termination point.

The NAA 24 is arranged to operate in one of a plurality of states. In the "idle" state, the NAA 24 is arranged to be off-line so that it is not in use other than for passing-through call requests, or ringing signals. In the "split-line" state, the NAA 24 is arranged to operate such that signals can be sent to the PSTN 12, or received therefrom, without being detected by the user of the particular NAA 24. In a "call-established" state, the NAA 24 becomes transparent to all signals passing therethrough and, when in the "configuration" state, the NAA 24 can be configured over the PSTN 12 from the DLLC 16.

The NAA 24 is arranged to be totally transparent to, and unaffected by, incoming calls and supervisory states, including line reversals, and also to be unaffected by other signals received and passed to the "call-established" state when the customer main equipment 20 is moved to an "off-hook" state. When disconnected from the network, and/or when unpowered, the NAA 24 is arranged to enter the "idle" state.

Further, the NAA 24 is arranged to change to the

"split-line" state immediately the user commences dialling, and to change from the "split-line" state when the NAA 24 network-call-set-up signalling sequence is completed, or following a prior time-out. System tones received at port 30 do not cause the NAA 24 to enter the "split-line" state.

With particular reference to the illustrated embodiment, entry of the NAA 24 to the "configuration" state can only be achieved when the NAA 24 is in the "call-established" state. The user can cause the NAA 24 to enter the "configuration" state by manipulation of switch 48.

The action of entering the "configuration" state serves to delete the current configuration exhibited by the NAA 24 and also serves to delete the current call access codes found in the NAA 24 and to render the NAA 24 ready to accept incoming signals from the down-line loading centre 16. Once the NAA 24 is fully loaded, or if the configuration process is interrupted or in error, the NAA 24 is arranged to pass to the "call-established" state.

In the "idle" state, a galvanic transmission path is maintained between the ports 26, 30 so that the NAA 24 is transparent to all signals coming from the network 10.

When the NAA 24 is in the "split-line" state no transmission path between the ports 26 and 30 is provided and when the NAA 24 is in the "call-established" state, a galvanic transmission path is established and maintained between the ports 26, 30 so that, as with the "idle" state, the access apparatus 24 is transparent to all signals.

Upon the detection of a "clear" condition, the customer main equipment 20 is returned to an "on-hook" state and the NAA 24 is arranged to return to the "idle" state.

As regards the memory 40, as mentioned above, the memory 40 is arranged to comprise a control program memory location 42 and the configuration data memory location 44.

The control program memory location 42 is arranged to be non-volatile and is loaded prior to the supply of the NAA 24 to the customer. The code stored in this location is arranged to be standard to all access apparatus relating to a particular firmware release. The control program memory is capable of being reprogrammed as required for new releases of firmware although this reprogramming operation is arranged to be carried out by the supplier and is not achieved by way of the remote down-line loading system.

However, in accordance with the present invention, the user data memory 44, which is also arranged to be non-volatile, is arranged to be configured by down-line loading process from the DLLC 16. In this manner, each particular NAA 24 can be down-loaded with appropriate data specifically tailored to the individual needs of each respective customer and, as will be appreciated, this configuration and subsequent re-configuration, occurs with the NAA 24 connected at the customer location.

The NAA 24 according to the present invention is particularly advantageous in that it is flexible in operation and takes its main control logic from the memory that is loaded remotely from the DLLC 16. The down-line loading protocol is described further below.

In general, the user data memory 44 is arranged to be of sufficient size so as to contain the configuration details as incorporated within the main program, the options and data-tables, the call access codes and any appropriate listings. The user data memory 44 is also arranged to contain all required configuration details and,

for example, should not be less than 512 bytes. Further, the user data memory 44 is arranged to be of sufficient size to meet the appropriate requirements for additional national number group codes and, as such, the memory 44 has sufficient capacity to store all the required national number groups.

When initially supplied to a customer, the user data memory 44 is blank so that, in this state, the NAA 24 allows straight-through dialling.

As mentioned above, the down-line loading procedure is arranged to utilise multi-frequency signalling to and from the NAA 24 for both the initial handshake signalling and the subsequent actual data transfer. This feature advantageously removes the need for a true modem-type communication system. The logic used by the NAA 24 for interpreting the dialled digits is arranged to be controlled entirely by the program information loaded from the down-line loading centre 16. This advantageously provides for particular flexibility so that the down-line loading centre 16 can, as and when required, configure the processor and load this to replace the original table stored in the user data memory 44, as and when the NAA 24 needs to perform different number translations.

The down-line loaded state table and data tables are arranged to process some, if not all, of the following call-request information, such as particular local access codes, the cost centre code option, public switched telephone network access codes, customer authorisation codes, private branch exchange personnel identification and/or cost centre numbers and value added feature codes for selection of any required intelligent network services or features. The NAA 24 is arranged to be placed in the configuration mode for receiving the down-line loaded

configuration information from the down-line loading centre 16 by manipulation of the switch 48. The same, or different, switch can be arranged to be manipulated when it is required to clear the configuration data from the NAA 24.

The NAA 24 is arranged to interpret the digits dialled by the user and to make appropriate digit insertions, deletions and/or translations which will cause the call to be directed along the appropriate route or to the appropriate service provider as required. The internal logic of the NAA 24 is determined by way of a programmable state machine as described further below. Further, the NAA 24 can be arranged to be configured so as to work with single- or two-stage access, as determined by the nature of the access available on the customers telephone line. With the exception of the use of cost centre codes and value added services, the operation of the NAA 24 appears completely transparent to the user who unless he wishes to use an alternative option simply has to dial the normal Directory or IN Number to which connection is required. When indirect access to a particular system is required, the NAA 24 automatically generates the required local access code and, where necessary, the customer authorisation code, so that for the default option the user is not then required to manually dial any other code. The NAA 24 permits the user to use alternative local access options and the NAA 24 is arranged to provide for straight-through dialling to ensure that all emergency services etc. are routed through the local system. The NAA 24 is also arranged to recognise, and pass through unaltered, codes such as a public switched telephone access digit, network barring, cost centre codes along with IN feature and list codes, public switched telephone network access codes, private network access codes, calling-line identification inhibit codes, particular specialised service codes and

local area calls which are dialled without a national number group prefix.

Any particular given NAA 24 requires a subset of the above as determined by its intended use and whether it is connected to a private branch exchange extension or to a direct exchange line.

The NAA 24 is arranged to allow alternative access codes or IN features to be used when a user wishes to override the default settings of the NAA 24, by the use of a User Entry Code.

The NAA 24 is advantageously arranged to identify supervisory conditions and signal codes received from any public switched telephone network direct exchange line or private branch exchange extension line; move to the next state as programmed by the state table upon identification of the appropriate line conditions and signal code, and send the network call set-up signalling sequence, which is determined by the NAA 24 program, to the public switched telephone network or private branch exchange.

A particularly advantageous feature of the present invention is that it allows for the remote configuration and re-configuration of the NAA 24, via the PSTN 12, from a remotely located down-line loading centre 16. Another advantageous feature is the ease of access to features of the applicable system and services.

In particular, a customer can have the NAA 24 configured when the customer main equipment 20 is connected to the network through the NAA 24, by gaining access to the down-line loading centre 16 and having the NAA 24 placed into the configuration state so as to load data into the memory of the NAA 24 in accordance with the remote

configuration protocol. This protocol is arranged to provide the required user entry codes and their related network routeing and Intelligent Network feature options, the cost centre code length and the private branch exchange to public switched telephone network access option. When required for a particular network access code, the appropriate customer authorisation code can also be configured. The protocol also provides for the loading of state-tables into the NAA 24 which are then used to translate the user's call set-up code sequence to a network call set-up sequence. Also, exclusion lists, which normally contain national number groups or directory numbers which should be routed through the local default system by removing the particular network access code, are produced along with amendments to the NAA 24 when new configuration options, special services and other lists, and customer authorisation codes, are required.

In order to enable the NAA 24 to cope with the required number manipulation and to provide a high degree of "future-proofing", the NAA 24 is advantageously arranged to be capable of being configured with a set of rules that define the number manipulation logic.

In order to configure, or re-configure, the NAA 24, it is arranged such that the user can dial a specified number so as to make contact with the DLLC 16 which is responsible for down loading the correct configuration data to the NAA 24.

The course of events is then, for example, as follows.

The DLLC 16 answers the query from the user and prompts for the user's phone number if the calling line identification code is not available within the network or cannot be captured by the DLLC 16. The entered number is

then used to determine what national number group the user is calling from if the calling line identification code is not available. Once the particular phone number has been determined, the platform responds with a request for confirmation of the number.

The DLLC 16 may be arranged to interrogate the user as regards whether they have requested the cost centre code option and, following a yes response, the user is then asked to enter data representative of the number of digits in the cost centre code.

Once the aforementioned process is complete, the DLLC 16 then commences the down loading process for re-configuring the NAA 24.

As mentioned above, the NAA 24 can be placed in the configuration mode by manipulation of the appropriate switch 48 as and when requested by the DLLC 16. When the switch 48 has been appropriately manipulated, a specific signal is sent to the DLLC 16.

If no response is received from the NAA 24 within a defined period, the user is deemed not to have a functioning NAA 24 and this leads to a generation of an appropriate message. If an acknowledgement tone is received by the DLLC 16, the required configuration/re-configuration information is loaded. The information down-loaded from the DLLC 16 may be in the form of a state table comprising a feature code portion, a data portion and a checksum portion. Codes are provided to indicate the beginning of the state table and also to indicate that no further data is to be down-loaded to the NAA 24.

The checksum is provided to increase data integrity. The checksum is calculated by adding all the down-loaded

data digits and is represented as a variable number of digits as required.

The NAA 24 is arranged to achieve a "time-out" if no further data is received within the time-out period. Also, the NAA 24 is arranged to check the checksum and return a status signal to the DLLC 16 to indicate successful, or otherwise, receipt of the configuration information. If no status information is received within the time-out period by the DLLC 16, then the DLLC 16 is arranged to repeat the transmission of the configuration information. The time-out period can be changed if required in accordance with the present invention.

Advantageously, the NAA 24 is arranged such that the user can check the particular NAA 24 configuration, or his own understanding of the configuration, by making appropriate test calls.

In use, and as noted above, the NAA 24 provides routeing through any particular applicable system and/or intelligent network features by the automatic generation of particular access and feature codes. The NAA 24 is arranged to recognise and give particular treatment to codes which prefix the network access codes, such as the PSTN access digit and the calling line identification inhibit codes. The NAA 24 is arranged to enable the user, if permitted by the particular configuration, to intervene by entering a user entry code to cause other network access and feature codes to be used or for the appropriate default system to be accessed.

In order to achieve a user call set-up signalling sequence, the NAA 24 is arranged to receive the following information from the user. First, if the NAA 24 is connected to a private branch exchange extension, a public

switched telephone network access code is required from the user. Next, the user enters a call-line identification inhibit code which prevents display of the call-line identification. Then, the user entry code, which can normally comprise a single digit, followed by the "*" sign, is entered and which defines, within the NAA 24, the network access code required by the user for access to that network, the intelligent network features or any available override options. Further, the NAA 24 is arranged to transmit the cost centre code and also the required directory number or the customers intelligent network list number as appropriate. The above represents a particular list of the parameters available and the NAA 24 is provided with a configuration that sets the parameters available to particular users, such as their length and the access and intelligent network features required by that customer. Furthermore, the cost centre code can be omitted even if included as a configuration option and the user entry code does not normally have to be entered unless the user is required or wishes to override the default routeing decision process defined by the NAA 24 configuration. The use of codes which include an appropriate symbol, for example a "*", enables the NAA 24 to readily identify the presence of the particular code. Also, the cost centre code option requires the user to dial a two or three item digit number followed by the "*" sign. The availability, or length, of the cost centre code option is dependent on the customers requirement and the subsequent NAA 24 configuration. If the NAA 24 is configured to accept the cost centre code option, and the cost centre code is not entered, or completed, the cost centre code will be treated as 00 or 000, dependent upon whether the cost centre code configured is two or three digits in length.

From the above, it will be appreciated that the user call set-up sequence order is as follows; first the public

switched telephone network local access code, then the call line identification inhibit code, next the user entry code, then the cost centre code and finally the directory number, or, if access to an intelligent network service is being provided, the list number, are provided.

Of course, if the NAA 24, as in the present example, is connected to an extension of a private branch exchange 22, the public switched telephone network access code, usually 9, and the directory number, or list number, are entered separately if the user sends the call line identification inhibit code, user entry code and/or the cost centre code.

To prevent unacceptable delays the NAA 24 is arranged to pass from the "split-line" state to the "call-established" state following a defined interruption in the user call set-up digit stream to enable system supervisory tones to be heard by the user. Before the national number group has been identified, the NAA 24 is arranged to pass to the "call-established" state after a time-out period has elapsed since the receipt of the last dialled digit. For example, when the national number group within the directory number has been identified, the NAA 24 shall pass to the "call-established" state after three seconds have elapsed since the receipt of the last dialled digit. This time-out arrangement ensures that unacceptable delays will not occur following receipt of an incomplete user call set-up signalling sequence.

When the user performs a call set-up sequence, a line-seize is generated by the terminal equipment and the multi-frequency signal code sequence is sent to the NAA 24. Upon commencement of the multi-frequency signal code sequence, the NAA 24 is arranged to enter the "split-line" state immediately upon receipt of the first dialled digit;

monitor and store codes dialled by the user; determine the required network access code in accordance with the translation process and attend to the translation of the user call set-up sequence received at the port 26 of the NAA 24. The PSTN call set-up sequence sent through the port 30, can be governed for each user entry code by using the remotely configured state tables. Further, the NAA 24 is arranged to send the network call set-up digit stream to the network termination point or the private branch exchange and, on completion of the digit stream, or passage of the time-out, the NAA 24 is arranged to enter the "call-established" state.

Pauses may be interposed by the configuration between each part of the call set-up sequence as required by the particular configuration.

In a single-stage access process, the following code sequence, or appropriate parts of the code sequence, are sent to the PSTN 12 by the NAA 24. First a public switched telephone access code is sent which is removed by the private branch exchange 22. Next a calling line identification inhibit code is sent followed by the particular network access code, and finally a directory number or list number is sent. On completion of the routeing procedure, the call is established within the PSTN 12.

In accordance with a two-stage access process, the following code sequence, or appropriate parts of the sequence, is sent. First, and as before, a local access code is sent followed by a calling line identification inhibit code which itself precedes a cost centre code or customer authorisation code. Finally, following a pre-set pause, during which any required or appropriate network tone may be received from the PSTN 12, the directory number

or list number is sent as required.

On completion of the aforementioned routeing procedure, the call is established within the PSTN 12.

The NAA 24 is arranged to provide a transmission path for all the network traffic once the initial call has been set-up using the access apparatus digital translation logic. The change-over from call set-up mode to call-established mode is arranged to take place at the point when the NAA 24 has no further processing to perform.

A portion of the exterior surface of the NAA 24 can be provided with a visual indicator which can be arranged to provide indication of when a call is being routed through a particular applicable system, or to a particular intelligent network service. Also, battery-low and power fail conditions can be arranged to be indicated by the aforesaid visual indicator and/or a audio output device. The warning system is arranged to be operable whether the connected device is a telephone, or a facsimile machine, and so this shall include the case when no handset is connected to a facsimile machine. Advantageously, the NAA 24 is arranged to reset and not hang in a loop should the user dial an incorrect, or incomplete, number sequence.

If the user "clears-down" and then immediately releases the line, by replacing the handset only momentarily, the NAA 24 is advantageously arranged to prevent a by-pass condition. When in a programming state, the NAA 24 is advantageously arranged to allow for the remote interrogation of its hardware and firmware version numbers by the DLLC 16.

Further, a particularly advantageous use of the present invention can be achieved if a plurality of NAA 24

devices is arranged to be used in series with items or groups of customers main equipment, or on certain private branch exchange extensions, in that the users of the customer main equipment connected in this way can be allocated their own access feature. For example, if a customer has both a telephone approved for connection to the network termination point, or to separate private branch exchange extensions, each with its own NAA 24 configured with appropriate user entry code options, the modem can be routed to the intelligent network through one local access code, whereas the telephone would be routed by way of another local access code.

It will therefore be appreciated that the present invention can provide for particularly advantageous microprocessor-controlled CNAE which can be located between items of the customer's main equipment, and the customer's network termination point and which operates by interrogating the call set-up sequence dialled by the user and, as a result, sends a code sequence that serves to provide access to a particular network route or to particular network services. The apparatus does not suffer disadvantages found in known CNAE in that, if customer network codes are changed, local access codes or further intelligent network services included into the overall network, it is not necessary to attend to the generally expensive, time consuming and inconvenient process of removing the CNAE from the network termination point for subsequent configuration. In accordance with the present invention, the NAA 24 can be remotely re-configured from a remote location by information down-loaded over the network and to the customer's network termination point.

In particular, the NAA 24 according to the present invention can be supplied to a customer in an unconfigured state and which, before it is first used, is configured,

and, as appropriate in the future, reconfigured, so as to meet the customers particular requirements as regards those network routes that will be considered to be more cost effective to that particular user and also having regards to the particular intelligent network services that each user will require.

In a particularly advantageous and adaptable manner, the NAA 24 of the present invention therefore enables a customer to minimise the call charges without the need for any detailed knowledge of the local area national number groups and to gain automatic access to intelligent network features without the need to input long access codes.

Particular advantages arising from the present invention are that the network access can be readily used on a private branch extension in a situation where the directory number can be prefixed by the PSTN access digit. Also, a default access procedure can be made available where, on dialling the directory number or intelligent network list number, the call is automatically routed through the appropriate network system by the addition of the appropriate system access codes by the NAA 24. If the default operation is not required, the dialling of a single digit user entry code, which permits the user to make use of alternative local access codes or require access to the local system, may be provided for. The invention also provides for the automatic transmission of a customer authorisation code which can be employed when calling line identification is not available.

An exclusion table can be entered during configuration which causes local and special service calls to be routed through the local applicable system.

The invention is not restricted to the details of the

foregoing embodiment. For example, the apparatus of the present invention does not have to comprise NAA 24 for connection between customer main equipment and a private branch exchange. An apparatus can alternatively be connected directly to a network termination point. Also, the features of the present invention can be provided in any particular form or "intelligent" terminal equipment such that the apparatus could be provided as part of a network termination mode or as part of the customers main equipment or indeed as part of an "intelligent" private branch exchange.

It will be appreciated that other modifications and variations may be made to the embodiment described and illustrated within the scope of the present application.

CLAIMS

1. Network access apparatus comprising input means for receiving network access information from network terminal equipment, processing means for receiving said input information, output means connected to said processor means and for delivering the processed signal to said network, said processing means being arranged to determine the route of said information over said network on the basis of configuration information received by the processing means, wherein said processor means has means for receiving said configuration information from said network and storing the same for subsequent use.

2. Apparatus as claimed in claim 1, wherein said processing means is arranged to be configured, and subsequently re-configured, by said configuration information when required.

3. Apparatus as claimed in claim 1 or 2, and arranged to receive network access information comprising multi-frequency signalling information.

4. Apparatus as claimed in any one of the preceding claims, wherein said processing means is arranged to receive configuration information comprising multi-frequency signalling information.

5. Apparatus as claimed in any one of the preceding claims, and arranged to receive network access information from telecommunications terminal equipment.

6. Apparatus as claimed in any one of the preceding claims, wherein said processing means has internal logic states arranged to be determined by a programmable state machine.

7. Apparatus as claimed in any one of the preceding claims, and arranged to provide for a transmission path for all communication traffic once the initial call has been set up using digit translation logic of the processing means.

8. Apparatus as claimed in any one of the preceding claims, wherein said processor is arranged for operation with a control program memory location and a user data memory location.

9. Apparatus as claimed in claim 8, wherein said control program memory is non-volatile.

10. Apparatus as claimed in claim 8 or 9, wherein said user data memory is non-volatile and arranged to receive said configuration information from the network.

11. Apparatus as claimed in claim 8, 9 or 10, wherein said user data memory is arranged to receive configuration information comprising a program for defining dialled-number manipulation logic.

12. Apparatus as claimed in any one of claims 8 to 11, wherein said user data memory is arranged to receive and store configuration details including data tables received from the network.

13. Apparatus as claimed in any one of the preceding claims, and arranged for operation in any one of a first state in which the access apparatus is off-line and can only be used to pass ringing signals, a second state in which signals can be delivered between the access apparatus and the network termination point but are not delivered to the network terminal equipment, a third state in which the access apparatus is transparent to all signals and a fourth

state in which said processing means can receive said configuration information from said network.

14. Apparatus as claimed in any one of the preceding claims and arranged for connection on a private branch exchange extension.

15. Apparatus as claimed in any one of the preceding claims, wherein said access apparatus is configured to route a user's call on the basis of the likely least-cost route available.

16. Apparatus according to any one of the preceding claims, wherein said access apparatus is arranged to route a requested call to the intelligent network feature required by the user.

17. Apparatus according to any of the preceding claims and arranged to place imposed barring on defined routes within the network on the basis of the configuration information received from the network.

18. Apparatus according to any one of the preceding claims, wherein said processor is arranged to operate checksums so as to confirm said configuration information delivered from said network has been correctly received.

19. Apparatus as claimed in any one of the preceding claims and arranged to allow for the passage of a request from the telecommunications terminal equipment to said network so as to commence the supply of configuration information from a Down-Line Loading Centre.

20. Apparatus as claimed in any one of the preceding claims and including a default setting and means for overriding said default setting to offer further access

options.

21. Network access apparatus comprising input means for receiving network access information from network terminal equipment, processing means for receiving said input information, output means connected to said processor means and for delivering the processed signal to said network, said processing means being arranged to determine the route of said information over said network on the basis of configuration information received by said processing means, wherein said apparatus has a default setting and means for overriding said default setting to offer further access options.

22. Apparatus as claimed in claim 20 or 21, wherein said default setting can be overridden by means of a dialled code.

23. Network access apparatus substantially as described hereinbefore with reference to Figs. 1 and 2 of the accompany drawings.

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Databases (see below)
(i) UK Patent Office collections of GB, EP, WO and US patent specifications.

(ii) ONLINE DATABASES: WPI

Documents considered relevant following a search in respect of Claims :-
1 TO 20

Categories of documents

X: Document indicating lack of novelty or of inventive step.

Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.

A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages		Relevant to claim(s)
X	GB 2218595 A	(STC) whole document	1 to 12, 20 at least
X	EP 0426911 A1	(HEWLETT-PACKARD) Abstract	1,2 at least
X	US 5276729	(OKI) Abstract	1 to 6 at least
X	US 5161184	(DIGITAL TELECOMMUNICATIONS) column 4 line 28 to column 5 line 61, column 13 lines 9 to column 14 line 24	1 to 12 at least

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